Deep Beauty, Understanding the Quantum World through Mathematical Innovation, *Hans Halvorson (Ed.)* , Cambridge Univ. Press., 2011, 472 pages, ISBN: 978-1-107-00570-9 (hc), $99.00 .

Deep Beauty is the product of an initiative by John Templeton Foundation that brought together a group of seventeen distinguished scientists to Princeton, New Jersey for a two-day conference in October 2007, on the philosophical foundations of physics. Despite the fact that invited speakers were given free rein to speak on whatever they chose, the conference's topics converged on new mathematical foundations that could potentially support both general relativity and quantum field theory. Under expert guidance and editorial direction, the participants later expanded their talks into coherent sections.

Deep Beauty has been structured into two large sections, Category Theory, and Operator Algebras, with twelve different subsections developed independently by the different author teams. John Baez and Aaron Lauda opened the book with an amazing review of the development of the n-category theory, tracing it development through the contributions of many of the scientists involved in development of General Relativity, Quantum field theory, and the quest for Quantum Gravity. Along this path, topics such as Feynman diagrams, Yang-Mills theory, Penrose tensor diagrams, braiding, Knot theory, Spin networks, Ponzano-Regge Model, Quantum link invariants, Yang-Baxter equation, Quantum groups, Chain complexes, and Tangles were explained and brought under the magic of category theory. Five more subsections by different authors expanded the reach of categories to include the Universe of processes, Topos methods, Daseinisation, Observables, and Bohrification. In the second large section, Operator Algebras , overviews of mathematics involved in the vacuum state, Algebraic Quantum Field theories, Entanglement, Hidden Variables, and Operational structures for General Probabilistic theories were done. I found the second section a little more philosophical and physics focused, ending with a delightful proof of The Strong Free Will theorem by John Conway and Simon Kochen.

Overall, I found this book unique in that it focused on explaining the foundational ideas and the historical development of the foundational ideas. There was sufficient background information and mathematical precision that the discussion flowed intelligibly even if you were not a specialist in the many diverse topics. For the detailed foundational mathematics involved, it was amazing that the essence of topics were so clearly explained without one having to master all the nitty-gritty mathematics. Furthermore, everything given was mostly self-contained, with each section followed by extensive reference list for further research if desired.

A topic index is found at the end of the book, which I found useful numerous times. The diagrams of Deep Beauty were something for which enormous care was taken, and it greatly added to understandability of the final product. Formatting, equations, and layout were all beautifully done. For me, a strength of Deep Beauty was the much richer and deeper appreciation of category theory that I gained. For a book that covers a vast area of leading edge mathematics, it is simply a delightful read, and I highly recommend it to anyone with an undergraduate degree in mathematics.

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